DTIG

Defense Threat Information Group

The Surface-to-Air Missile System
MSAM / MRADS / Vityaz

Special report

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MSAM / MRADS / Vityaz

DoD / NATO-Code:	n.k	n.k.
System:	**MSAM / MRADS / Vityaz**	**MSAM / MRADS / Vityaz**
Missile:	**9M100**	**9M96E / 9M96M**
Length:	2.50 m	4.75 m
Body diameter:	125 mm	240 mm
Wing span:	n.k.	480 mm
Propulsion:	Solid propelled rocket with thrust vectoring	Solid propelled rocket
Launch weight:	n.k.	333 kg
Warhead:	n.k.	26 kg FRAG-HE
Fuse:	contact & proximity fuses	contact & radar proximity fuses
Average speed:	n.k.	900 m/s
Range:	10 km	1-40 km
Ceiling:	n.k.	5-20000 m
Guidance:	INS + IR	INS + ARH

Manufacturer:

System: Almaz / Antey Concern of Air Defence
Missiles: Fakel Design Bureau

Development:

Development of a mobile MSAM / MRADS / Vityaz began in the early 1990s with a series of successful system firings against various target types. It was unveiled in 1998 by Almaz concern and is roughly a counterpart of the European SAMPT. It is probable that the system is mainly aimed at the export market and is designed to complement the S-300 / S-400 missile family.
MRADS.
South Korea is developing a simplified version of the Vityaz called Cheolmae-2 with the help of Almaz Central Design Bureau. The Cheolmae-2 will be comprised of an X-band multi-function radar vehicle built by Almaz , a command post vehicle and several transporter-erector-launchers for Koreanized 9M96 missiles. The prime contractor is Samsung Thales, a joint venture between Samsung Electronics and Thales of France.

Description:

A typical **MSAM** battery unit comprises a shelter-mounted fire-control system with integral radar that carries out target surveillance and tracking functions, three missile container-launcher platforms and a missile resupply vehicle. All three components are mounted on the same forward control (6 × 6) cross-country truck chassis. The basic missile load per battery is 48 weapons. Each truck-mounted launcher assembly has three layers of four ready-to-fire missiles in their cylindrical container-launchers which, when in the travelling configuration, are in the horizontal position. For cold launching the missiles to a height of about 30-m (where the weapon's main rocket motor sustainer ignites) they are swung into the vertical position at the rear of the vehicle. All of the component system vehicles use four hydraulically operated outriggers to stabilise themselves at the battery launch site. Each battery also has its own auxiliary power unit. The component vehicles use an inter-vehicle datalink to pass information back and forth with the fire-control system. Reload missiles in their container-launchers are loaded by means of a crane.
The most intriguing characteristic of the **MRADS / Vityaz** is that it is a dual-missile system, whereby each of the standard containers can be replaced by a pack of four smaller and shorter weapons. Its main components are a truck-mounted vertical launcher and the phased array radar with fast-rotating antenna for improved performance. The first variant of the launcher carried twelve tubular containers, but a year later a revised design was presented with ten containers and the current version is down to eight. The larger missile for the system is probably the **9M96** originally designed for the S-400 system, while the smaller one has not been unveiled yet and might be either the Antey **9M100** or an adaptation of the design of another design bureau. This missile is intended for self-defence at a range of up to 15 km and features passive IR homing guidance. The 9M96 is a dual-role anti-missile and anti-aircraft missile The smaller 9M100 missile are designed for use against aircraft, UAVs and cruise missiles.

The 9M100 is a short-range, IR-guided missile that has been mentioned as both a SAM and an AAM. The 9M96E missile are ‘hit-to-kill’ designed for direct impact, and use canards and thrust vectoring to achieve extremely high G and angular rate capability. An inertial package is used with a datalink from the MFMTR X-band radar for midcourse guidance, with a radar homing seeker of an undisclosed type. The small 24kg blast fragmentation warhead is designed to produce a controlled fragment pattern, using multiple initiators to shape the detonation wave through the explosive. A smart radar fuse is used to control the warhead timing and pattern. It is in effect a steerable shaped charge. The launch box contains one of the following three missile load outs:

- 10 9M96E
- 32 9M100
- 5 9M96E and 10 9M100

According to Almaz, Vityaz could replace older SAMs like the S-125 while adding multiple-target and anti-missile capabilities. According to information released in 2003, the system can be delivered in two configurations: a version optimised for protecting against high-precision weapons (cruise missiles, ARMs, smart bombs and tactical UAVs) able to simultaneous engage up to eight targets, and a multi-role version, in the former configuration the battery consists of a radar and up to four launchers with 32 "small" missiles each, while in the latter the heart of the battery is a mobile command post linked to up to two radars and up to eight launchers. The KamAZ 8x8 trucks are used as carriers but any other truck with the load capacity of 10 tons may carry the launchers or the containerised radar station and command post.
The roof-mounted **MFMTR** X-band phased array radar of the fire-control system can detect and track up to 40 targets simultaneously and engage eight of them typically using two missiles per target to ensure a high-kill probability. The MSAM is capable of engaging aircraft, helicopters, UAVs and tactical ballistic missile target sets. The MFMTR radar provides a Simultaneous target detection, multiple target tracking and the missile up-link. The radar contains a Rotating phased-array antenna (60 rpm) with Full electronic scanning, with large deflection (+/- 45° in elevation and bearing). With electronic beam steering, very low sidelobes and a narrow pencil beam mainlobe, the MFMTR phased array is more difficult to detect and track by an aircraft’s warning receiver when not directly painted by the radar, and vastly more difficult to jam. While it may have detectable backlobes, these are likely to be hard to detect from the forward sector of the radar. As most anti-radiation missiles rely on sidelobes to home in, the choice of engagement geometry is critical in attempting to kill a MFMTR.
This radar provides a highly mobile 3D search and acquisition capability, but is limited in low level coverage footprint by its antenna elevation. The specialised MFMTR is a high power-aperture, coherent, X-band phased array designed for the rapid acquisition and initial tracking of inbound ballistic missiles within a 90 degree sector. The primary search waveform is chirped to provide a very high pulse compression ratio intended to provide very high range resolution of small targets. The design uses a high power Travelling Wave Tube (TWT) source, very low side lobes and frequency hopping techniques to provide good resistance to jamming. Russian sources are unusually detailed on ECCM techniques used, claiming the use of three auxiliary receiver channels for cancelling side lobe jamming, automatic wind compensated rejection of chaff returns, and provisions in the MTI circuits to reject jamming. A facility for precise angular measurement of jamming emitters is included. RMS tracking errors are quoted at 250 metres in range and about 0.5 degrees in azimuth/elevation.

Status:

In development. Prototype system firing trials have taken place. The current status of the programme is unknown, and future developments may be related to the progress in the tests of the more capable S-400 system. Offered for export.